C. The Commission Should Adopt a Rule Permitting the Installation of Equipment Boxes in Unusable Space

In NextG's experience, some utilities continue to categorically refuse to allow NextG, and presumably other wireless attachers, to attach equipment boxes to poles. There is no valid safety or engineering basis for the refusal. The NESC again has rules that address appropriate working space and climbing space and as long as those rules can be met, such attachments should be permitted. In its 1998 order declaring wireless devices to be "attachments," the Commission noted that wireless attachments may include "a communications cabinet at the base of the pole" [32] And NESC Rule 235I(3) expressly permits the attachment of equipment boxes that support a communications antenna.[33] The Commission has recognized that it is standard industry practice to attach such equipment boxes, and that equipment located in unusable space is excluded from the one foot allocation.[34]

Of course, some utilities who refuse to allow NextG to install equipment boxes have installed similar equipment of their own on the poles – including wireless equipment for use in remote meter reading – or permit the attachment of equipment to poles, particularly in the unusable space. Indeed, the attachment of equipment to poles has been standard industry

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[32] 13 FCC Rcd. 6777 at ¶ 41; *see also*, Public Notice (stating "the Commission [has] determined that wireless telecommunications providers are entitled to the benefits and protections of section 224 for the attachment to utility poles of antennas or antenna clusters and ***associated equipment.***" (emphasis added)).

[33] *See* Attachment 2, NESC Rule 235I(3) ("The clearance between an equipment case that supports a communications antenna and a supply line conductor shall not be less than the value given in Table 235-6, Row 4a.").

[34] *See, e.g., Texas Cablevision Co. v. Southwestern Elec. Power Co.*, 1985 FCC LEXIS 3818 at ¶ 6 (1985) ("[I]n adopting a standard one foot for space deemed occupied by the cable itself, the Commission not only included that space occupied by the cable itself, but also the space ***associated with any equipment normally required*** by the presence of the cable television attachment. ... Moreover, to the extent that this ancillary equipment may occupy the 18-28 feet designated as "ground clearance," which by definition is excluded from the usable space, it is deemed to be omitted from any measurements" (emphasis added)).

practice. ILECs and cable operators historically have attached equipment boxes of various size and purpose. Verizon and AT&T, in particular, have attached large equipment boxes to utility poles as part of their recent fiber deployments Thus, the limitations on equipment attachment imposed by some utilities – purportedly on the basis of nebulous concerns about safety – are unfounded.

NextG respectfully submits, therefore, that the Commission should adopt a rule establishing a presumption that equipment related to telecommunications attachments is allowed on utility poles. To rebut the presumption, a pole owner should be required to obtain an order from the Commission that as to specific equipment on a particular pole there is conclusive evidence of insufficient capacity, or safety, reliability, and generally applicable engineering purposes that cannot be remedied through engineering solutions that are acceptable under generally applicable engineering or safety standards.

D. The Commission Should Adopt a Rule Permitting Qualified Electrical Workers to Perform Make-Ready and to Install and Maintain Wireless Attachments

NextG has encountered difficulties with some electric utilities that require the use of their own employees to perform pole surveys, make-ready work and to install and maintain wireless attachments. This creates significant problems of delay for NextG and adds unnecessary cost to the overall installation. Where such a delay is likely, NextG would like to use qualified electrical contractors, in accordance with NESC Rule 235I(1) ("Communications antennas located in the supply space shall be installed and maintained only by personnel authorized and qualified to work in the supply space ... ."). The utilities' policies flatly conflict with the Commission's ruling regarding the use of qualified electrical workers:

> a utility may require that individuals who will work attaching or making ready attachments of telecommunications ... facilities to utility poles, in the proximity of electric lines, have the same qualifications, in terms of training, as the utility's

own workers, but ***the party seeking access will be able to use any individual workers who meet these criteria.***[35]

In light of some utilities' failure to heed this Commission precedent, NextG submits that the Commission should promulgate a rule expressly permitting the use of qualified electrical contractors, and clarify that the rule applies to wireless devices and related equipment, as well as wireline attachments.

E. The Commission Should Adopt a Rule Prohibiting Utilities from Declaring Street Light Poles And Distribution Poles With "Primary" Attachments "Off Limits" to Wireless Attachments

NextG has encountered certain utilities that categorically and arbitrarily deny access to a large portion of their utility poles for the attachment of wireless devices. While the Commission has ruled that while Section 224 does not apply to transmission towers and or poles carrying only interstate transmission facilities, federal law affords attaching parties non-discriminatory access to distribution poles and transmission poles when they are utilized in the local distribution network.[36] Nonetheless, some utilities are ignoring the Commission's rulings and imposing severe limitations on the universe of poles that are available for wireless attachments. For example, a major utility in the northeast will not permit pole top attachments on any pole with facilities carrying more than 600 Volts, which NextG estimates comprises roughly 85 to 90 percent of the utility's poles. As another example, a major electric utility in the southeastern U.S. (*see* Section I(B)) arbitrarily defines "distribution poles" as only those poles with facilities

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35 *Implementation of the Local Competition Provisions of the Telecommunications Act of 1996; Interconnection between Local Exchange Carriers and CMRS Providers*, Order on Reconsideration, 14 FCC Rcd. 18049 at ¶ 86 (1999) (emphasis added).

36 *See Omnipoint Corp. v. PECO Energy Co.*, Memorandum Opinion and Order, 15 FCC Rcd. 5484 at n. 18 (2003) ("We note that PECO argues that attachments to its transmission facilities are not covered by the Pole Attachment Act. We agree with PECO, but only to the extent that the transmission facilities are interstate and not part of a local distribution system."); *Southern Company v. FCC*, 293 F.3d 1338, 1345-1346 (11th Cir. 2002).

transporting electricity of 25 kiloVolts or less, and categorically denies access to all other poles. Other utilities have denied NextG's requests to attach wireless facilities to street light poles, or requested exorbitant unregulated rental rates for such attachments, although such poles are ideal for wireless facilities and can safely accommodate communications antennas.[37] Thus, the practical effect of such policies is to deny NextG access to the a large portion of the universe of majority of its poles and also to deny access to taller poles, which generally are more desirable for antenna placement.

These restrictions are arbitrary and unlawfully limit NextG's access to utility poles that should be available for attachments. The NESC is the primary standard governing the attachment of wireless service facilities to utility poles and certainly constitutes "generally applicable engineering standards" as determined by the Commission. Contrary to the policies of some utilities, the NESC ***expressly permits*** the attachment of "communications antennas in the supply space" on poles with conductors carrying voltages of ***up to 814 kV.***[38] Moreover, NESC Rule 235I(1) requires that "Communications antennas located in the supply space shall be installed and maintained only by personnel authorized and qualified to work in the supply space" – *i.e.*, utility technicians or qualified contractors – so it cannot be reasonably argued that such policies are necessary to ensure worker safety. Finally, NextG notes that FERC Account 364 (poles, towers and fixtures), the primary investment account used to compute pole attachment rates, includes not only wood poles, but also poles made of "steel, concrete, or other materials."[39]

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37 *See* Attachment 5, a NextG DAS antenna attached to a street light pole in Del Mar, California.

38 *See* Attachment 2, NESC Rule 235I and Table 235-6 (line 1b) (emphasis added).

39 *See* 18 C.F.R. § 364.

Thus, street light poles, which often are made of steel, are no different than traditional wood poles.

In light of these utility abuses, the Commission should promulgate a rule specifying that all poles owned by a utility (except those carrying only interstate transmission facilities) are presumptively available for wireless attachments. To rebut the presumption, a pole owner should be required to obtain an order from the Commission based on conclusive evidence that a particular proposed attachment to a particular pole is unsuitable for attachment based on conclusive evidence of safety, reliability, and generally applicable engineering problems that cannot be remedied through engineering solutions that are acceptable under generally applicable engineering or safety standards.

F. The Commission Should Establish a Presumption That Wireless Attachments That Comport with the NESC and FCC and OSHA Regulations May Not Be Denied on the Basis of Safety or Reliability

In its dealings with utilities throughout the country, NextG has encountered a host of nebulous, unfounded objections to its proposed wireless attachments, typically on the basis of alleged concerns about: (i) clearances between antennas and power lines; (ii) RF emissions; (iii) pole loading; (iv) wind, snow and ice loading; and (v) climbing and working space. However, each of these concerns is already adequately addressed in the NESC and/or FCC and Occupational Health and Safety Administration ("OSHA") regulations.

As discussed above, **clearances** between power lines and communications antennas, as well as between equipment boxes and power lines are already addressed by the NESC and are not legitimate grounds for excluding wireless facilities. The NESC expressly addresses clearance requirements for the attachment of pole top antennas and other communications equipment located in the supply space. For instance, NESC Rule 235I governs "[c]learances in any direction from supply line conductors to communication antennas located in the supply

space [*i.e.*, pole top] attached to the same supporting structure."[40] Similarly, NESC Rule 239H controls the "[r]equirements for vertical communication conductors passing through supply space on jointly used structures."[41] NESC Rule 235I(1) further requires that "[c]ommunications antennas located in the supply space shall be installed and maintained only by personnel authorized and qualified to work in the supply space. ... ."[42] Consequently, as long as the "authorized and qualified personnel" install the antennas and other facilities in accordance with these rules, clearance issues are adequately addressed.

Pole owners sometimes raise alleged concerns about worker exposure to **RF emissions.** Such assertions are unfounded because the safety of RF emissions from wireless attachments already is subject to comprehensive regulation by the Commission and OSHA.[43] The Commission's standards are based substantially on the recommendations of the U.S. Environmental Protection Agency and the Food and Drug Administration, and reflect "the best scientific thought" on the RF limits necessary to "protect the public health."[44] These standards protect the public and utility workers from any RF emissions from wireless devices attached to utility poles. So long as a wireless attachment is within the Commission's standards for maximum permissible exposure for general population uncontrolled exposure, utilities must be prohibited from citing RF emissions as grounds for denying access.

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40 *See* Attachment 2, NESC Rule 235I.

41 *See* Attachment 2, NESC Rule 239H

42 *See* Attachment 2, NESC Rule 235I(1).

43 *See* 47 C.F.R. § 1.1310 (FCC RF emissions rules); FCC Office of Engineering and Technology Bulletins 56 and 65; 29 C.F.R. §§ 1910.97 and 1910.268 (OSHA regulations).

44 *See Guidelines for Evaluating the Environmental Effects of Radiofrequency Radiation*, Report and Order, 11 FCC Rcd. 15123 at ¶ 2 (1996).

Concerns about **pole loading** due to wireless attachments are unfounded because the impact of antennas and associated equipment on a pole's strength and loading is significantly less than that created by overhead power lines and related power equipment. Utility concerns about the effect of **snow, ice and wind** are equally baseless. Any wind and ice loading issues raised by the attachment of antennas are addressed by the NESC and are no different than issues incident to any other type of pole attachment. There is nothing special about NextG's antennas and equipment boxes simply because they are "wireless." The attachment of wireless antenna on pole tops are covered by designing the antenna attachment using hardware of sufficient capacity to support the antenna during weather conditions addressed in the NESC. The NESC takes into account the weather conditions prevalent where the pole is located. Specifically, Section 25 of the NESC, titled "Loadings for Grades B and C," defines the physical loads (*i.e.*, ice, wind and temperature conditions) that facilities attached to utility poles must be able to withstand and the load factors that apply.[45] In short, any pole loading issues raised by the attachment of wireless devices are addressed by adherence to the NESC.

Moreover, wind, snow, and ice loading are no more an issue for wireless equipment than they are for wireline. Indeed, as demonstrated by studies performed by an NESC expert for NextG, the wind loading impact of NextG's antennas is significantly less than the wire spans attached between nodes.[46] If there are loading issues, they can be dealt with on a pole specific

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[45] NESC Rule 250B establishes three general degrees of loading due to prevailing weather conditions, specifically the combined effect of ice and wind. NESC Rule 250C establishes extreme wind loading standards for poles taller than 60 feet, while NESC Rule 252 specifies how to apply ice and wind loading on poles and other line supports. In addition, NESC Rule 012C requires consideration of loads caused by the local conditions that may adversely affect the stress on the fasteners, support components, and the supporting structure itself (*i.e.*, the pole). *See* Attachment 2, NESC Rules 012C, 250B, 250C and 252.

[46] *See* Attachment 3, Declaration of David Marne, submitted to the New York Public Service Commission with NextG's comments in the NY PSC's *Proceeding on Motion of the*

basis (*e.g.*, through make-ready or pole change out). There is *no* basis to categorically object to wireless attachments based on alleged loading concerns.

Finally, with respect to **climbing space** and **work space** issues, NESC Rules 236 and 237 ensure that climbing space and work space are adequately maintained.[47] For example, NESC Rule 236D(1) provides that "[a]ll supply and communications equipment ... when located below conductors or other attachments, shall be mounted outside of the climbing space."[48] Moreover, because wireless equipment is no more burdensome to a pole than other equipment already permitted on poles by pole owners (*e.g.*, electric transformers), wireless devices raise no unique issues with respect to climbing and work space.

Thus, NextG requests that the Commission adopt a rebuttable presumption that wireless attachments that comply with the NESC and relevant FCC and OSHA regulations must be permitted on utility poles. Such a rule is needed to prevent unfounded denials of access to utility poles and the imposition of arbitrary standards beyond those of the NESC and other governing codes and regulations, which NextG has experienced all too often.

V. CONCLUSION

Based on the foregoing comments, NextG respectfully submits that the Commission should adopt rules that explicitly recognize and protect wireless attachments, including the following:

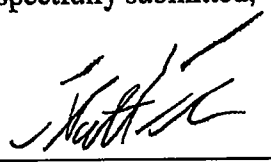
Commission Concerning Wireless Facility Attachments to Utility Distribution Poles, NY PSC Case 07-M-0741 (filed Sept. 10, 2007); Attachment 4, Reply Declaration of David Marne, submitted to the Commission by NextG in the FCC complaint proceeding *NextG Networks of NY, Inc. v. Public Service Electric & Gas Co.*, File No. EB-07-MD-004 (filed Feb. 11, 2008).

47 *See* Attachment 2, NESC Rules 236 and 237.

48 *See* Attachment 2, NESC Rule 236(D)(1).

- a rule that the rate applicable to wireless attachments equals the utility's telecommunications pole attachment rate multiplied by the number of feet of useable space actually occupied by the wireless attachment;
- a rule that pole top attachments must be allowed;
- a rule prohibiting allowing ADSS fiber installation in the "power space" on poles and prohibiting pole owners from categorically prohibiting attachments to any part of the pole where the attachments would comply with NESC standards;
- a rule permitting the installation of equipment boxes in unusable space;
- a rule permitting attaching parties to use any qualified electrical workers to perform make-ready work and to install and maintain attachments, including wireless attachments;
- a rule prohibiting utilities from declaring street light poles and poles with attachments above a certain voltage "off limits" to wireless attachments;
- rules mandating performance of preconstruction surveys and completion of make-ready work within the specific timeframes set forth above; and
- a rule establishing a presumption that wireless attachments that comport with the NESC and FCC and OSHA regulations may not be denied on the basis of safety or reliability.

Respectfully submitted,



T. Scott Thompson
James W. Tomlinson
DAVIS WRIGHT TREMAINE LLP
1919 Pennsylvania Avenue, N.W., Suite 200
Washington, D.C. 20006
Tel. (202) 973 - 4200
Fax. (202) 973 - 4499
ScottThompson@dwt.com
JimTomlinson@dwt.com

Robert L. Delsman
NEXTG NETWORKS, INC.
2216 O'Toole Ave
San Jose, CA 95131
Tel. (408) 954-1580
RDelsman@NextGNetworks.net

Counsel for NextG Networks, Inc.

March 7, 2008

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of Implementation of Section 224 of the Act; Amendment of the Commission's Rules and Policies Governing Pole Attachments	WC Docket No. 07-245 RM-11293 RM-11303

Declaration of Norine Luker

I, Norine Luker, declare and state as follows:

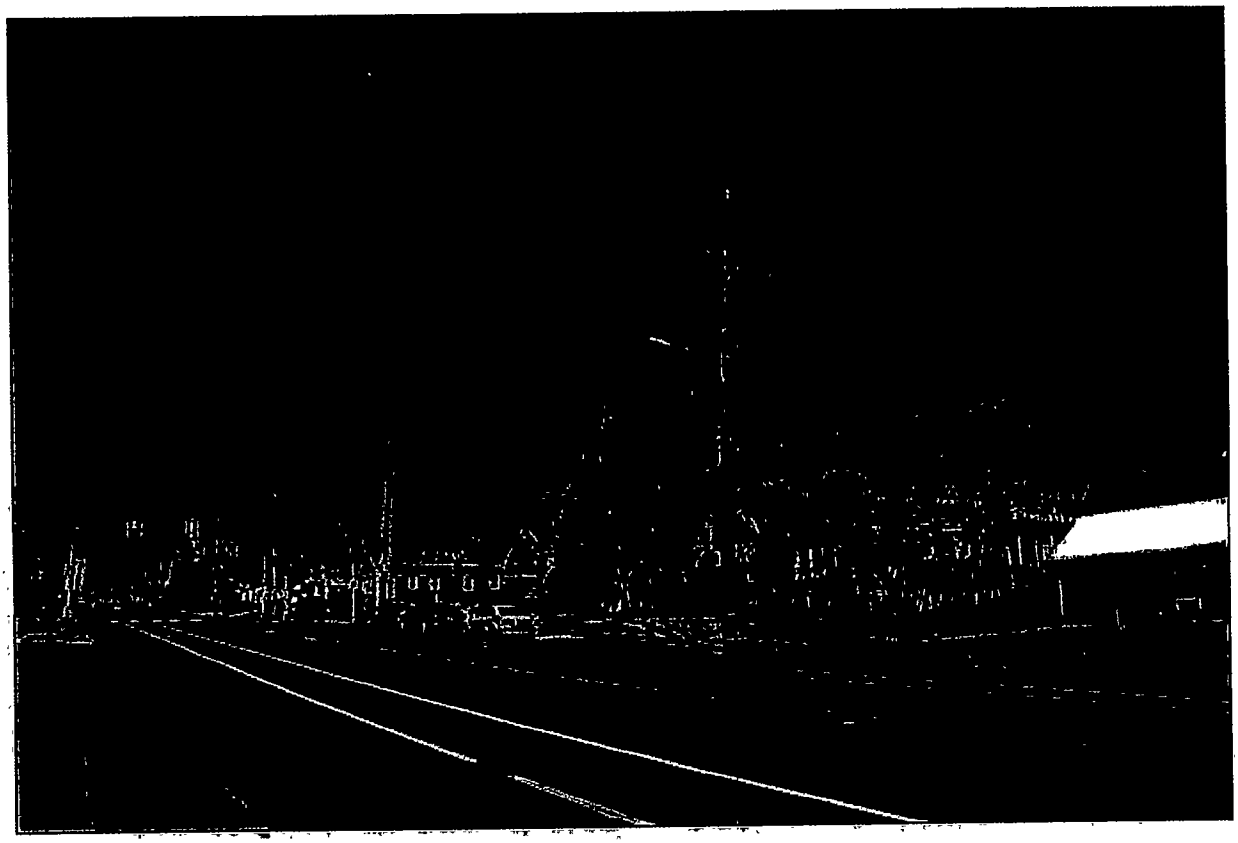
1. I am Senior Director of Utility Administration for NextG Networks, Inc. ("NextG"). My primary duty at NextG is to work with pole owning utility companies to secure NextG's right to attach to utility poles.

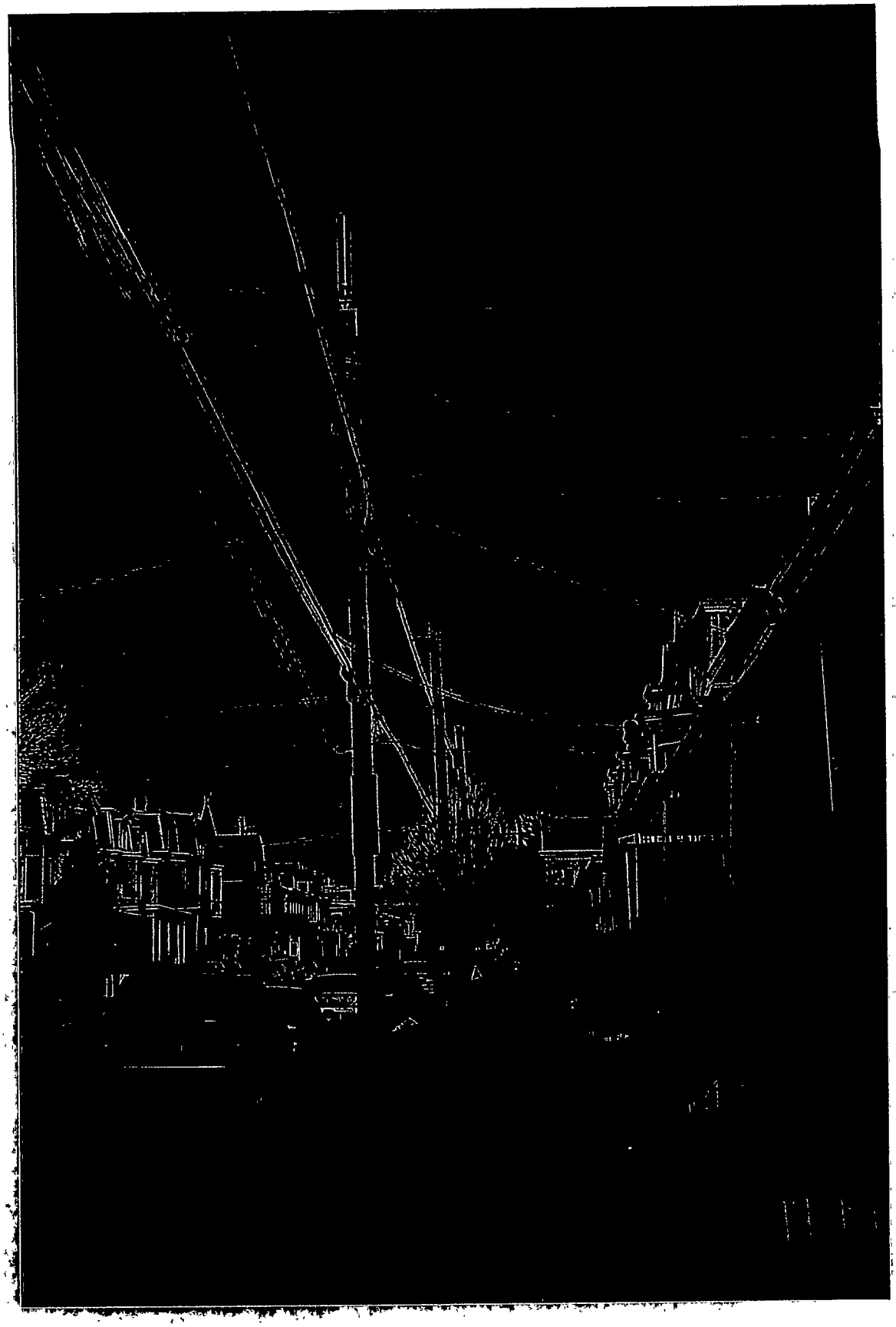
2. I make this Declaration in response to questions posed by the Federal Communications Commission in the captioned proceeding and in support of the Comments of NextG Networks, Inc.

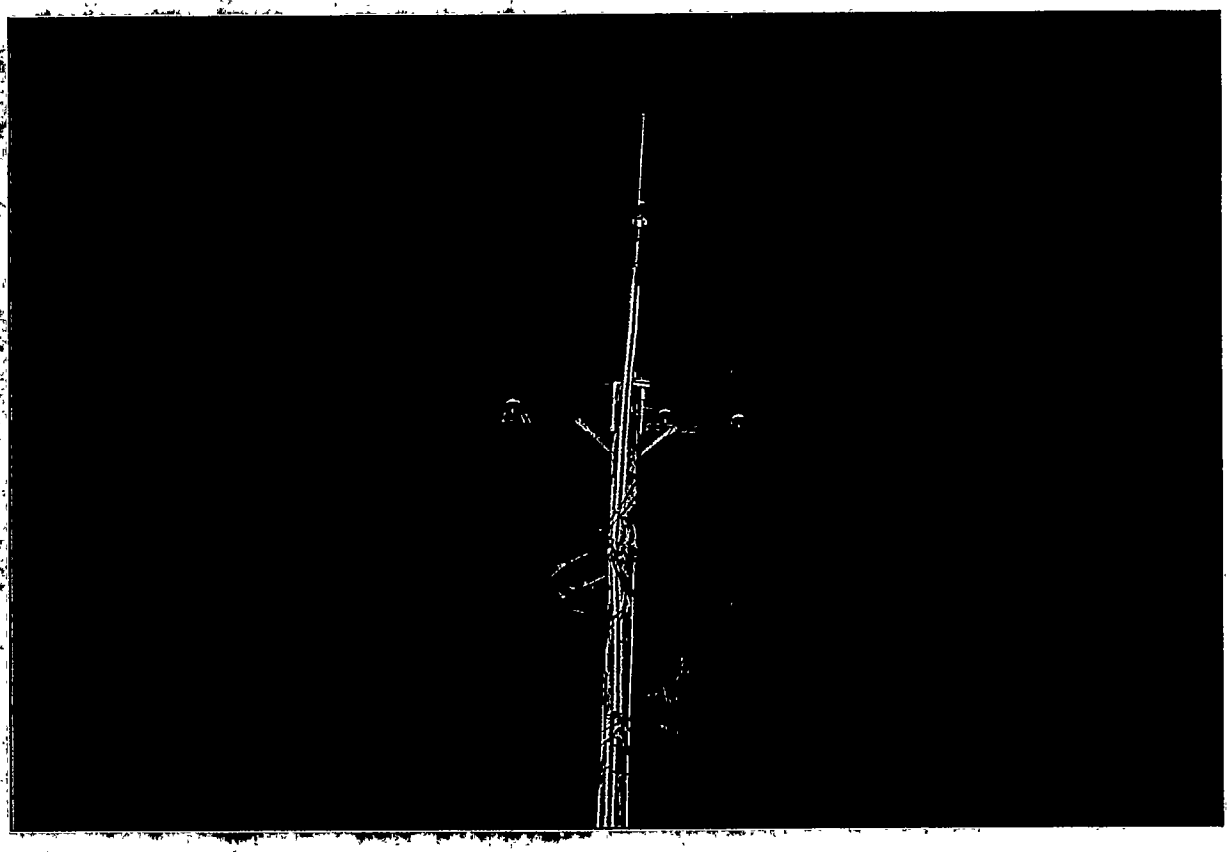
3. I declare that the factual information contained in the Comments of NextG Networks, Inc. ("NextG") with respect to NextG's experiences related to attaching its facilities on utility poles is true and correct to be the best of my belief and knowledge.

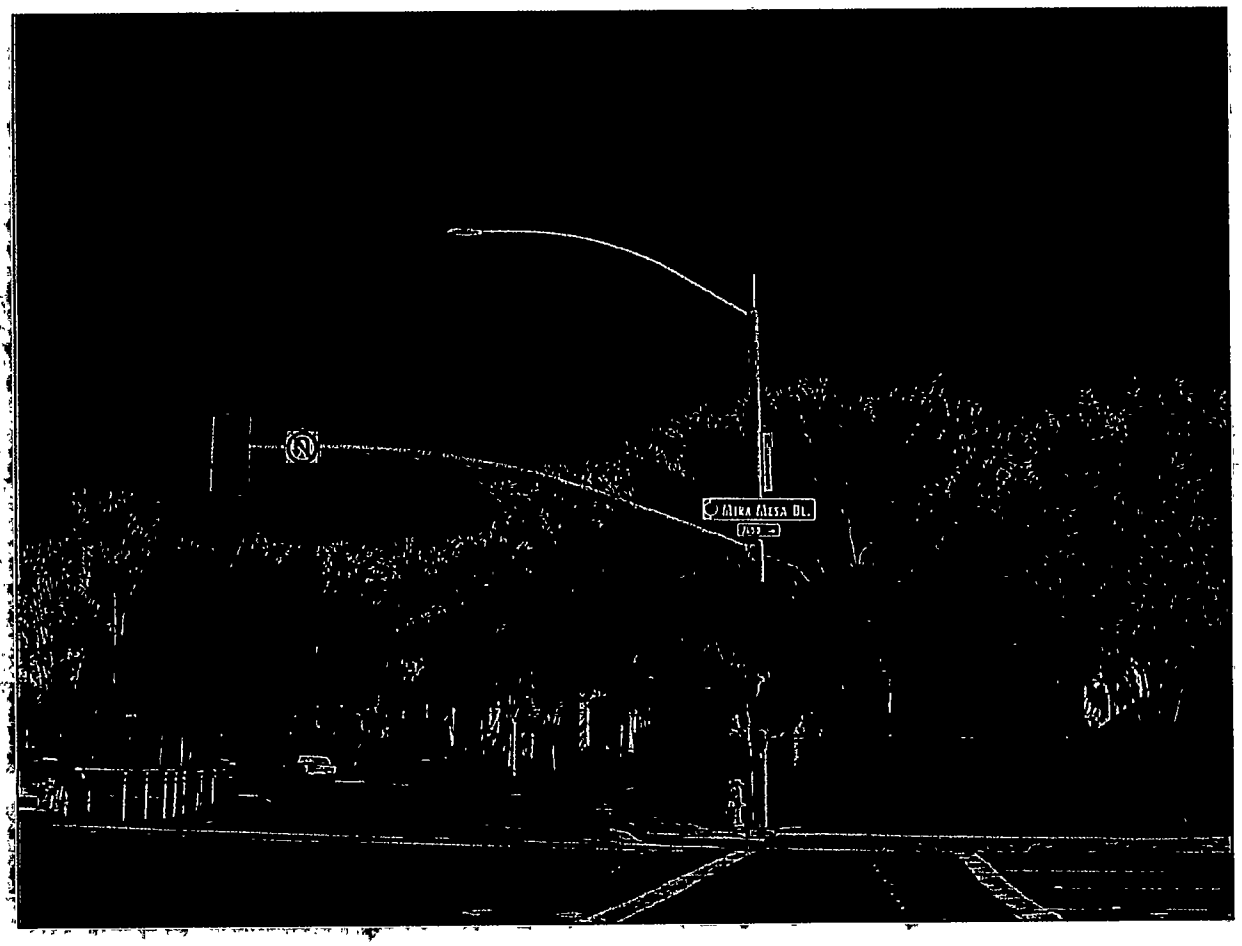
Norine Luker

Attachment 1
Pictures of Representative NextG DAS Installations








MIRA MESA DR.

Attachment 2
Pertinent Rules of the
National Electrical Safety Code ("NESC")

Accredited
Standards
Committee
C2-2007

National Electrical Safety Code®

Secretariat
Institute of Electrical and Electronics Engineers, Inc.

Approved 20 April 2006
Institute of Electrical and Electronics Engineers, Inc.

Approved 16 June 2006
American National Standards Institute

2007 Edition

Abstract: This standard covers basic provisions for safeguarding of persons from hazards arising from the installation, operation, or maintenance of (1) conductors and equipment in electric supply stations, and (2) overhead and underground electric supply and communication lines. It also includes work rules for the construction, maintenance, and operation of electric supply and communication lines and equipment. The standard is applicable to the systems and equipment operated by utilities, or similar systems and equipment, of an industrial establishment or complex under the control of qualified persons. This standard consists of the introduction, definitions, grounding rules, list of referenced and bibliographic documents, and Parts 1, 2, 3, and 4 of the 2007 Edition of the National Electrical Safety Code.

Keywords: communications industry safety; construction of communication lines; construction of electric supply lines; electrical safety; electric supply stations; electric utility stations; high-voltage safety; operation of communications systems; operation of electric supply systems; power station equipment; power station safety; public utility safety; safety work rules; underground communication line safety; underground electric line safety

The Institute of Electrical and Electronics Engineers, Inc.
3 Park Avenue, New York, NY 10016-5997, USA

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1 August 2006 SH95514

Section 1.
Introduction to the
National Electrical Safety Code®

010. Purpose

The purpose of these rules is the practical safeguarding of persons during the installation, operation, or maintenance of electric supply and communication lines and associated equipment.

These rules contain the basic provisions that are considered necessary for the safety of employees and the public under the specified conditions. This Code is not intended as a design specification or as an instruction manual.

011. Scope

A. These rules cover supply and communication lines, equipment, and associated work practices employed by a public or private electric supply, communications, railway, or similar utility in the exercise of its function as a utility. They cover similar systems under the control of qualified persons, such as those associated with an industrial complex or utility interactive system.

B. The NESC covers utility facilities and functions up to the service point.

NOTE: The National Electrical Code® (NEC®) (NFPA 70, 2005 Edition)① covers utilization wiring requirements beyond the service point.

C. NESC rules cover street and area lights (supplied by underground or overhead conductors) under the exclusive control of utilities (including their authorized contractors) or other qualified persons (such as those associated with an industrial complex).

NOTE: Luminaires not under such exclusive control are governed by the requirements of the NEC.

D. NESC rules do not cover installations in mines, ships, railway rolling equipment, aircraft, or automotive equipment, or utilization wiring except as covered in Parts 1 and 3.

012. General rules

A. All electric supply and communication lines and equipment shall be designed, constructed, operated, and maintained to meet the requirements of these rules.

B. The utilities, authorized contractors, or other entities, as applicable, performing design, construction, operation, or maintenance tasks for electric supply or communication lines or equipment covered by this Code shall be responsible for meeting applicable requirements.

C. For all particulars not specified in these rules, construction and maintenance should be done in accordance with accepted good practice for the given local conditions known at the time by those responsible for the construction or maintenance of the communication or supply lines and equipment.

013. Application

A. New installations and extensions

1. These rules shall apply to all new installations and extensions, except that they may be waived or modified by the administrative authority. When so waived or modified, safety shall be provided in other ways.

①Information on references can be found in Section 3.

Communication circuits other than those used in connection with the operation of the supply circuits shall not be carried in the same cable with such supply circuits.

f. Where such supply conductors are carried below communication conductors, transformers and other apparatus associated therewith shall be attached only to the sides of the support arm in the space between and at no higher level than such supply wires.

g. Lateral runs of such supply circuits carried in a position below the communication space shall be protected through the climbing space by wood molding or equivalent covering, or shall be carried in insulated multiple-conductor cable, and such lateral runs shall be placed on the underside of the support arm.

C. Relative levels: Supply lines of different voltage classifications (0 to 750 V, over 750 V to 8.7 kV, over 8.7 kV to 22 kV, and over 22 kV to 50 kV)

1. At crossings or conflicts

Where supply conductors of different voltage classifications cross each other or structure conflict exists, the higher-voltage lines should be carried at the higher level.

2. On structures used only by supply conductors

Where supply conductors of different voltage classifications are on the same structures, relative levels should be as follows:

a. Where all circuits are owned by one utility, the conductors of higher voltage should be placed above those of lower voltage.

b. Where different circuits are owned by separate utilities, the circuits of each utility may be grouped together, and one group of circuits may be placed above the other group provided that the circuits in each group are located so that those of higher voltage are at the higher levels and that any of the following conditions is met:

(1) A vertical clearance of not less than that required by Table 235-5 is maintained between the nearest line conductors of the respective utilities.

(2) Conductors of a lower voltage classification placed at a higher level than those of a higher classification shall be placed on the opposite side of the structure.

(3) Ownership and voltage are prominently displayed.

D. Identification of overhead conductors

All conductors of electric supply and communication lines should, as far as is practical, be arranged to occupy uniform positions throughout, or shall be constructed, located, marked, numbered, or attached to distinctive insulators or crossarms, so as to facilitate identification by employees authorized to work thereon. This does not prohibit systematic transposition of conductors.

E. Identification of equipment on supporting structures

All equipment of electric supply and communication lines should be arranged to occupy uniform positions throughout or shall be constructed, located, marked, or numbered so as to facilitate identification by employees authorized to work thereon.

221. Avoidance of conflict

Two separate lines, either of which carries supply conductors, should be so separated from each other that neither conflicts with the other. If this is not practical, the conflicting line or lines should be separated as far as practical and shall be built to the grade of construction required by Section 24 for a conflicting line, or the two lines shall be combined on the same structures.

222. Joint use of structures

Joint use of structures should be considered for circuits along highways, roads, streets, and alleys. The choice between joint use of structures and separate lines shall be determined through

cooperative consideration of all the factors involved, including the character of circuits, the total number and weight of conductors, tree conditions, number and location of branches and service drops, structure conflicts, availability of right-of-way, etc. Where such joint use is mutually agreed upon, it shall be subject to the appropriate grade of construction specified in Section 24.

223. Communications protective requirements

A. Where required

Where communication apparatus is handled by other than qualified persons, it shall be protected by one or more of the means listed in Rule 223B if such apparatus is permanently connected to lines subject to any of the following:

1. Lightning
2. Contact with supply conductors whose voltage to ground exceeds 300 V
3. Transient rise in ground potential exceeding 300 V
4. Steady-state induced voltage of a hazardous level

Where communication cables will be in the vicinity of supply stations where large ground currents may flow, the effect of these currents on communication circuits should be evaluated.

NOTE: Additional information may be obtained from IEEE Stds 487™-2000 [B34] and 1590™-2003 [B54].

B. Means of protection

Where communication apparatus is required to be protected under Rule 223A, protective means adequate to withstand the voltage expected to be impressed shall be provided by insulation, protected where necessary by surge arresters used in conjunction with fusible elements. Severe conditions may require the use of additional devices such as auxiliary arresters, drainage coils, neutralizing transformers, or isolating devices.

224. Communication circuits located within the supply space and supply circuits located within the communication space

A. Communication circuits located in the supply space

1. Communication circuits located in the supply space shall be installed and maintained only by personnel authorized and qualified to work in the supply space in accordance with the applicable rules of Sections 42 and 44.
2. Communication circuits located in the supply space shall meet the following clearance requirements, as applicable:
   a. Insulated communication cables supported by an effectively grounded messenger shall have the same clearances as neutrals meeting Rule 230E1 from communication circuits located in the communication space and from supply conductors located in the supply space. See Rules 235 and 238.
   b. Fiber-optic cables located in the supply space shall meet the requirements of Rule 230F.
   c. Open-wire communication circuits permitted by other rules to be in the supply space shall have the same clearances from communication circuits located in the communication space and from other circuits located in the supply space as required by Rule 235 for ungrounded open supply conductors of 0–750 V.

   EXCEPTION: Service drops meeting Rules 224A3a and 224A3b may originate in the supply space on a line structure or in the span and terminate in the communication space on the building or structure being served.
3. Communication circuits located in the supply space in one portion of the system may be located in the communication space in another portion of the system if the following requirements are met:

a. Where the communication circuit is, at any point, located above an energized supply conductor or cable, the communication circuit shall be protected by fuseless surge arresters, drainage coils, or other suitable devices to limit the normal communication circuit voltage to 400 V or less to ground.

NOTE: The grades of construction for communication conductors with inverted levels apply.

b. Where the communication circuit is always located below the supply conductors, the communication protection shall meet the requirements of Rule 223.

c. The transition(s) between the supply space and the communication space shall occur on a single structure; no transition shall occur between line structures.

EXCEPTION: Service drops meeting Rules 224A3a and 224A3b may originate in the supply space on a line structure or in the span and terminate in the communication space on the building or structure being served.

d. The construction and protection shall be consistently followed throughout the extent of such section of the communications system.

B. Supply circuits used exclusively in the operation of communication circuits

Circuits used for supplying power solely to apparatus forming part of a communications system shall be installed as follows:

1. Open-wire circuits shall have the grades of construction, clearances, insulation, etc., prescribed elsewhere in these rules for supply or communication circuits of the voltage concerned.

2. Special circuits operating at voltages in excess of 90 V ac or 150 V dc and used for supplying power solely to communications equipment may be included in communication cables under the following conditions:

a. Such cables shall have a conductive sheath or shield that is effectively grounded, and each such circuit shall be carried on conductors that are individually enclosed with an effectively grounded shield.

b. All circuits in such cables shall be owned or operated by one party and shall be maintained only by qualified personnel.

c. Supply circuits included in such cables shall be terminated at points accessible only to qualified personnel.

d. Communication circuits brought out of such cables, if they do not terminate in a repeater station or terminal office, shall be protected or arranged so that in the event of failure within the cable, the voltage on the communication circuit will not exceed 400 V to ground.

e. Terminal apparatus for the power supply shall be so arranged that the live parts are inaccessible when such supply circuits are energized.

EXCEPTION: The requirements of Rule 224B2 do not apply to communication circuits where the transmitted power does not exceed 150 W.

225. Electric railway construction

A. Trolley-contact conductor fastenings

All overhead trolley-contact conductors shall be supported and arranged so that the breaking of a single contact conductor fastening will not allow the trolley conductor live span wire, or current-carrying connection, to come within 3.0 m (10 ft) (measured vertically) from the ground, or from any platform accessible to the general public.

Span-wire insulation for trolley-contact conductors shall comply with Rule 279B.

Section 23.
Clearances

230. General

A. Application

This section covers all clearances, including climbing spaces, involving overhead supply and communication lines.

NOTE: The more than 70 years of historical development and specification of clearances in Rules 232, 233, and 234 were reviewed for consistency among themselves and with modern practice and were appropriately revised in both concept and content for the 1990 Edition. See Appendix A.

1. Permanent and temporary installations

   The clearances of Section 23 are required for permanent and temporary installations.

2. Emergency installations

   The clearances required in Section 23 may be decreased for emergency installations if the following conditions are met.

   NOTE: See Rule 14.

   a. Open supply conductors of 0 to 750 V and supply cables meeting Rule 230C; and communication conductors and cables, guys, messengers, and neutral conductors meeting Rule 230E1 shall be suspended not less than 4.8 m (15.5 ft) above areas where trucks are expected, or 2.70 m (9 ft) above areas limited to pedestrians or restricted traffic only where vehicles are not expected during the emergency, unless Section 23 permits lesser clearances.

      For the purpose of this rule, trucks are defined as any vehicle exceeding 2.5 m (8 ft) in height. Areas not subject to truck traffic are areas where truck traffic is neither normally encountered nor reasonably anticipated or is otherwise limited.

      Spaces and ways subject to pedestrians or restricted traffic only are those areas where riders on horseback, vehicles, or other mobile units exceeding 2.5 m (8 ft) in height are prohibited by regulation or permanent terrain configurations or are otherwise neither normally encountered nor reasonably anticipated or are otherwise limited.

   b. Vertical clearances of open supply conductors above 750 V shall be increased above the applicable value of Rule 230A2a as appropriate for the voltage involved and the given local conditions.

   c. Reductions in horizontal clearances permitted by this rule shall be in accordance with accepted good practice for the given local conditions during the term of the emergency.

   d. Supply and communication cables may be laid directly on grade if they are guarded or otherwise located so that they do not unduly obstruct pedestrian or vehicular traffic and are appropriately marked. Supply cables operating above 600 V shall meet either Rule 230C or 350B.

   e. No clearance is specified for areas where access is limited to qualified personnel only.

3. Measurement of clearance and spacing

   Unless otherwise stated, all clearances shall be measured from surface to surface and all spacings shall be measured center to center. For clearance measurement, live metallic hardware electrically connected to line conductors shall be considered a part of the line conductors. Metallic bases of potheads, surge arresters, and similar devices shall be considered a part of the supporting structure.

4. Rounding of calculation results

Unless otherwise specified in a table or rule within Section 23 that requires a calculation, the resultant of the calculation shall be rounded up to the same level of decimal places as the basic value shown in the rule or table, regardless of the numbers of significant digits of individual values required to be used in the calculation.

EXCEPTION: Rules or tables with values in millimeters are shown in units of 5 mm; as a result, resultants of calculations to be expressed in millimeters shall be rounded up to the next multiple of 5 mm.

EXAMPLES: If the basic value shown in a rule or table has no decimal places, such as 3 in, the resultant will be rounded up to the next whole number. If the basic value shown in the table or rule is shown as having one decimal place, such as 18.5 ft, the resultant of the calculation will be rounded up to one decimal place. If the table or rule contains a basic value expressed in two decimal places, such as 1.27 m, the resultant will be rounded up to two decimal places.

B. Ice and wind loading for clearances

1. Three general degrees of loading due to weather conditions are recognized and are designated as clearance zones 1, 2, and 3. Figure 230-1 shows the zones where these loadings apply.

NOTE: The localities are classified in the different zones according to the relative simultaneous prevalence of the wind velocity and thickness of ice that accumulates on wires. Zone 3 is for places where little, if any, ice accumulates on wires. See Appendix B.

2. Table 230-1 shows the radial thickness of ice to be used in calculating sags for clearance purposes. See applicable clearance rules in Section 23.

3. Ice and wind loads are specified in Rule 230B1.

a. Where a cable is attached to a messenger, the specified loads shall be applied to both cable and messenger.

b. In determining wind loads on a conductor or cable without ice covering, the assumed projected area shall be that of a smooth cylinder whose outside diameter is the same as that of the conductor or cable. The force coefficient (shape factor) for cylindrical surfaces is assumed to be 1.0.

NOTE: Experience has shown that as the size of multiconductor cable decreases, the actual projected area decreases, but the roughness factor increases and offsets the reduction in projected area.

c. An appropriate mathematical model shall be used to determine the wind and weight loads on ice-coated conductors and cables. In the absence of a model developed in accordance with Rule 230B5, the following mathematical model shall be used:

(1) On a conductor, lashed cable, or multiple-conductor cable, the coating of ice shall be considered to be a hollow cylinder touching the outer strands of the conductor or the outer circumference of the lashed cable or multiple-conductor cable.

(2) On bundled conductors, the coating of ice shall be considered as individual hollow cylinders around each subconductor.

d. It is recognized that the effects of conductor stranding or of non-circular cross section may result in wind and ice loadings more or less than those calculated according to assumptions stated in Rules 230B3b and 230B3c. No reduction in these loadings is permitted unless testing or a qualified engineering study justifies a reduction.

4. Table 230-2 shows the radial thickness of ice, wind pressures, temperatures, and additive constants to be used in calculating inelastic deformation.

The load components shall be determined as follows:

a. Vertical load component

The vertical load on a wire, conductor, or messenger shall be its own weight plus the weight of conductors, spacers, or equipment that it supports, ice covered where required by Rule 230B1 and Table 230-2.

b. Horizontal load component

The horizontal load shall be the horizontal wind pressure determined under Rule 230B1 and Table 230-2, applied at right angles to the direction of the line using the projected area of the conductor or messenger and conductors, spacers, or equipment that it supports, ice *covered where required by Rule 230B1 and Table 230-2.*

c. Total load

The total load on each wire, conductor, or messenger shall be the resultant of components in a) and b) above, calculated at the applicable temperature in Table 230-2, plus the corresponding additive constant in Table 230-2.

5. Final sag calculations shall include the effects of inelastic deformation due to both (a) initial and subsequent combined ice and wind loading, and (b) long-term material deformation (creep). See applicable sag definitions. Ice is assumed to weigh 913 kg/m^3 (57 lb/ft^3).

C. Supply cables

For clearance purposes, supply cables, including splices and taps, conforming to any of the following requirements are permitted lesser clearances than open conductors of the same voltage. Cables should be capable of withstanding tests applied in accordance with an applicable standard.

1. Cables that are supported on or cabled together with an effectively grounded bare messenger or neutral, or with multiple concentric neutral conductors, where any associated neutral conductor(s) meet(s) the requirements of Rule 230E1 and where the cables also meet one of the following:
   a. Cables of any voltage having an effectively grounded continuous metal sheath or shield
   b. Cables designed to operate on a multi-grounded system at 22 kV or less and having semiconducting insulation shielding in combination with suitable metallic drainage
2. Cables of any voltage, not included in Rule 230C1, covered with a continuous auxiliary semiconducting shield in combination with suitable metallic drainage and supported on and cabled together with an effectively grounded bare messenger.
3. Insulated, nonshielded cable operated at not over 5 kV phase to phase, or 2.9 kV phase to ground, supported on and cabled together with an effectively grounded bare messenger or neutral.

D. Covered conductors

Covered conductors shall be considered bare conductors for all clearance requirements except that clearance between conductors of the same or different circuits, including grounded conductors, may be reduced below the requirements for open conductors when the conductors are owned, operated, or maintained by the same party and when the conductor covering provides sufficient dielectric strength to limit the likelihood of a short circuit in case of momentary contact between conductors or between conductors and the grounded conductor. Intermediate spacers may be used to maintain conductor clearance and to provide support.

E. Neutral conductors

1. Neutral conductors that are effectively grounded throughout their length and associated with circuits of 0 to 22 kV to ground may have the same clearances as guys and messengers.
2. All other neutral conductors of supply circuits shall have the same clearances as the phase conductors of the circuit with which they are associated.

F. Fiber-optic cable

1. Fiber-optic—supply cable
   a. Cable defined as "fiber-optic—supply" supported on a messenger that is effectively grounded throughout its length shall have the same clearance from communications facilities as required for a neutral conductor meeting Rule 230E1.

b. Cable defined as "fiber-optic—supply" that is entirely dielectric, or supported on a messenger that is entirely dielectric, shall have the same clearance from communications facilities as required for a neutral conductor meeting Rule 230E1.

c. Fiber-optic—supply cables supported on or within messengers not meeting Rule 230F1a or 230F1b shall have the same clearances from communications facilities required for such messengers.

d. Fiber-optic—supply cables supported on or within a conductor(s), or containing a conductor(s) or cable sheath(s) within the fiber-optic cable assembly shall have the same clearances from communications facilities required for such conductors. Such clearance shall be not less than that required under Rule 230F1a, 230F1b, or 230F1c, as applicable.

e. Fiber-optic—supply cables meeting Rule 224A3 are considered to be communication cables when located in the communication space.

2. Fiber-optic—communication cable

Cable defined as "fiber-optic—communication" shall have the same clearance from supply facilities as required for a communication messenger.

G. Alternating- and direct-current circuits

The rules of this section are applicable to both ac and dc circuits. For dc circuits, the clearance requirements shall be the same as those for ac circuits having the same crest voltage to ground.

NOTE: Although the corresponding crest voltage for a common sinusoidal ac circuit may be calculated by multiplying its rms value by 1.414 (square root of 2), this may not be appropriate for other type ac circuits. An example of the latter is represented by non-sinusoidal power supplies such as used in some coaxial cable type communication systems.

H. Constant-current circuits

The clearances for constant-current circuits (such as series lighting circuits) shall be determined on the basis of their normal full-load voltage.

I. Maintenance of clearances and spacings

The clearances and spacing required shall be maintained at the values and under the conditions specified in Section 23 of the applicable edition. The clearances of Section 23 are not intended to be maintained during the course of or as a result of abnormal events such as, but not limited to, actions of others or weather events in excess of those described under Section 23.

NOTE: See Rule 13 to determine the applicable edition.

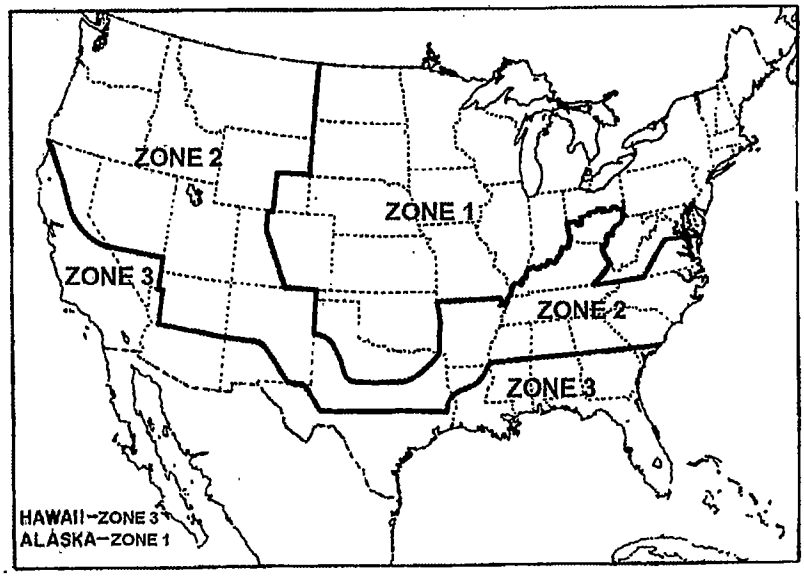

Figure 230-1—Clearance zone map of the United States